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BIRCH STEWART KOLASCH & BIRCH
PO BOX 747
FALLS CHURCH, VA 22040-0747

EXAMINER	
MIYOSHI, JESSE Y	

ART UNIT	PAPER NUMBER
2811	

NOTIFICATION DATE	DELIVERY MODE
11/25/2009	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mailroom@bskb.com

Office Action Summary	Application No.	Applicant(s)	
	10/564,486	SON, HYO-KUN	
	Examiner	Art Unit	
	JESSE Y. MIYOSHI	2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 July 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *33,34,36-44 and 46-54* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *33,34,36-44 and 46-54* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *7/6/2009*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. Claim 53 is objected to because of the following informalities: Claim 53 cannot depend upon itself. Appropriate correction is required.

2.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 33, 34, 36-44, 46-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Emerson et al. (U.S. PGPub 2003/0006418; hereinafter "Emerson") as evidenced by McIntosh et al. (U.S. 5,684,309; hereinafter "McIntosh") and Biwa et al. (U.S. PGPub 2002/0175341; hereinafter "Biwa").

Re claim 33: Emerson teaches (e.g. figure 1) a light emitting diode (LED), comprising: a first gallium nitride layer (**14**); an $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer (**16**) formed over the first gallium nitride layer (**14**); an active layer (**18**) formed over the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer (**16**); and a second gallium nitride layer (**32**) formed over the active layer (**18**); wherein the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi- layer (**16**) has a plurality of pits formed thereon.

In the remarks, it is clarified by the Applicant that the steps required for pit formation is by the growth of the multi-layer at different temperatures for each layer

comprising the multi-layer and the removal of H_2 during the growth process (page 3, lines 9-10) as well as the discussion pointed out by Applicant in paragraph [0043] which states InGaN/InGaN multilayer has a plurality of hexagonal pits formed thereon due to dislocations and defects resulting from the doped N-type GaN layer and defects resulting from the super lattice structure.

It is taught by Emerson at paragraph [0049] that the indium content in each of the layers comprising the superlattice structure **16** are **not equal**. Additionally, at paragraph [0051] that the superlattice structure **16** is grown on N-type GaN layer **14** in an atmosphere of nitrogen. Emerson does not explicitly specify that each layer is grown at a different temperature.

Biwa discusses the dependence that Indium content of InGaN has on temperature having he relationship of T=(1080-4.27X), where X denotes In content(%) discussed in paragraph [0015]. For example, 10-20% In content would have a growth temperature of 700-800˚C whereas GaN is higher than 1000˚C. Therefore, different growth temperatures result in differing In content in InGaN materials.

Therefore, the superlattice structure **16** of Emerson having alternating layers of $In_xGa_{1-x}N$ and $In_yGa_{1-y}N$ where $X \neq Y$, would require each layer to be grown at a different temperature.

Re claim 34: Emerson teaches the LED wherein the active layer (**18**) comprises an InGaN/InGaN structure of a multi-quantum well structure (**18**, multi quantum well structure; e.g. paragraph 52).

Re claim 36: Emerson teaches the device wherein the number of the pits is 50 or less per area of 5μm X 5μm. The formed pits are a result of the composition of the structure as disclosed in claim 33, therefore, since the structure recited in the prior art is substantially identical to that of the claim, claimed properties are presumed to be present. See MPEP 2112.01(i).

Re claim 37: Emerson teaches the LED wherein the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer is formed to have a super lattice structure (superlattice structure **16**).

Re claim 38: Emerson teaches the LED wherein each layer of the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer has a thickness of 1-3000Å (superlattice **16** have layers of about 5-40 angstrom; e.g. paragraph 49).

Re claim 39: Emerson teaches the device wherein the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer has a photoluminescence characteristic of a yellow band intensity/N-doped GaN intensity ratio of 0.4 or below. Since the structure recited in the prior art is substantially identical to that of the claim, claimed properties are presumed to be present. See MPEP 2112.01(i).

Re claim 40: Emerson teaches the active layer (**18**) being directly formed on the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer (**16**).

Re claim 41: Emerson teaches the LED wherein the LED is blue LED (visible spectrum; e.g. paragraph 3).

Re claim 42: Emerson teaches (e.g. figure 1) a method for manufacturing a light emitting device, the method comprising the steps of: forming an N-type gallium nitride layer (**14**); forming an $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer (**16**) above the N-type gallium

nitride layer (**14**), the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer (**16**) including layers of first and second growth temperatures (superlattice structure **16** having alternating layers of $In_xGa_{1-x}N$ and $In_yGa_{1-y}N$ where $X \neq Y$, would require each layer to be grown at a different temperature, reasons for different temperatures discussed below; e.g. paragraph 49); forming an active layer (**18**) above the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer (**16**); and forming a P-type gallium nitride layer (**32**) above the active layer (**18**), wherein the active layer (**18**) is grown at a temperature lower than the first and second temperatures (superlattice structure **16** exceeds the bandgap of the quantum well layers **120**, reasons for active layer growth temperature being below first and second temperatures will be discussed below; e.g. paragraph 61); and wherein the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer (**16**) has a plurality of pits formed thereon (as discussed above for claim 33, pits are present since the layers are grown on N-type GaN layer **14** at different temperatures in an atmosphere of nitrogen).

McIntosh at figure 10 shows that bandgap is greatest at GaN and the least when there is a highest Indium concentration in InGaN. Therefore, the higher the In content in InGaN, the lower the bandgap.

Biwa discusses the dependence that Indium content of InGaN has on temperature having he relationship of T=(1080-4.27X), where X denotes In content(%) discussed in paragraph [0015]. For example, 10-20% In content would have a growth temperature of 700-800˚C whereas GaN is higher than 1000˚C. Therefore, the lower the growth temperatures the higher In content present in InGaN materials.

As Emerson states at paragraph [0061], the quantum well layer **120** of the MQW structure **18** has a lower bandgap than that of the superlattice structure **16**. A lower bandgap InGaN material has higher Indium content, therefore, by the evidence of Biwa, quantum well layer **120** was grown at a lower temperature that would result in the higher Indium content of layer **120**.

Re claim 43: Emerson teaches the method wherein the active layer is grown at 600~800 °C (temperature is dropped 200˚C below 700-900˚C; e.g. paragraph 59).

Re claim 44: Emerson teaches the method wherein the active layer comprises an InGaN/InGaN structure of a multi-quantum well structure (**125**, InGaN quantum well and barrier layers; e.g. paragraph 57).

Re claim 46: Emerson teaches the device wherein the number of the pits is 50 or less per area of 5μm X 5μm. The formed pits are a result of the method of making structure as disclosed in claim 42, therefore, since the structure recited in the prior art is formed substantially identical to that of the claim, claimed properties are presumed to be inherent. See MPEP 2112.01(i).

Re claim 47: Emerson teaches the method wherein the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer is formed to have a super lattice structure (superlattice structure **16**).

Re claim 48: Emerson teaches the method wherein each layer of the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer has a thickness of 1-3000Å (superlattice **16** have layers of about 5-40 angstrom; e.g. paragraph 49).

Re claim 49: Emerson teaches the device wherein the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer has a photoluminescence characteristic of a yellow band intensity/N-doped GaN

intensity ratio of 0.4 or below. Since the structure recited in the prior art is substantially identical to that of the claim, claimed properties are presumed to be inherent. See MPEP 2112.01(i).

Re claim 50: Emerson teaches the active layer (**18**) being directly formed on the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer (**16**).

5. Claims 51-54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fukuda et al. (WO03005459; the disclosure evidenced by U.S. PGPub 2004/0155248; hereinafter "Fukuda") as evidenced by Tsujimura et al. (U.S. 6,614,059; hereinafter "Tsujimura") and Uchida et al. (non-patent literature titled "Photoluminescence characteristics and pit formation of InGaN/GaN quantum-well structures frown on sapphire substrates by low-pressure metalorganic vapor phase epitaxy"; hereinafter "Uchida").

Re claim 51: Fukuda teaches (e.g. figure 1) a light emitting diode (LED), comprising: a substrate (**1**); a buffer layer (**2**) on the substrate (**1**); an undoped GaN layer (**5**) on the buffer layer (**2**); an N-type GaN (**6**) layer directly formed on the undoped GaN layer (**5**); an $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer (**7**, **8**) directly formed on the N-type GaN layer (**6**); an active layer (**9**) directly formed on the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer (**7**, **8**); and a P-type GaN layer (**11**) formed on the active layer (**9**), wherein the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer has a plurality of pits formed thereon.

As discussed in paragraphs [0039] and [0043] which discusses a method of making an InGaN/InGaN multilayer and the InGaN/InGaN multilayer having a plurality of

hexagonal pits formed thereon due to dislocations and defects resulting from the doped N-type GaN layer and defects resulting from the super lattice structure.

Tsujimura at column 1, lines 40-45 and Uchida at page 246, column 2, lines 2-7 discusses the known formation of pits in InGaN/GaN multilayers. Since Fukuda discloses the general structure as claimed, during formation of the multilayer, a plurality of pits would have been formed.

Re claim 52: Fukuda teaches the LED, further comprising: a GaN layer (**3**) between the buffer layer (**2**) and the undoped GaN layer (**5**).

Re claim 53: Fukuda teaches the LED, wherein the undoped GaN layer (**5**) is directly formed on the GaN layer (**3**).

Re claim 54: Fukuda teaches the LED, wherein the active layer (**9**) comprises: an InGaN/InGaN structure (GaN/InGaN MQW; e.g. paragraph 32) of a multi-quantum well structure.

Claim 51 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biwa in view of Emerson.

Re claim 51: Biwa teaches (e.g. figure 8B) a light emitting diode (LED), comprising: a substrate (**40**); a buffer layer (**GaN** buffer layer; e.g. paragraph 64) on the substrate (**40**); an undoped GaN layer (**41**) on the buffer layer (**GaN**); an N-type GaN (**42**) layer directly formed on the undoped GaN layer (**41**); an active layer (**43**); and a P-type GaN layer (**44**) formed on the active layer (**43**).

Biwa is silent as to an $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer directly formed on the N-type GaN layer; an active layer directly formed on the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer, wherein the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer has a plurality of pits formed thereon.

Emerson teaches an $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer (**16**; e.g. paragraph 49) directly formed on the N-type GaN layer (**14**); an active layer (**18**) directly formed on the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer (**16**), wherein the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer (**16**) has a plurality of pits formed thereon.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use the teachings of Emerson in the device of Biwa in order to provide a better surface on which the active layer can be formed (see paragraph 50 of Emerson).

The combined structure of Biwa modified by Emerson teaches each and every limitation of the claim except explicitly stating the plurality of pits formed within the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer. Applicant in paragraph [0043] which states InGaN/InGaN multilayer has a plurality of hexagonal pits formed thereon due to dislocations and defects resulting from the doped N-type GaN layer and defects resulting from the super lattice structure. Evidence that the multilayer (**16**) grown on the N-type GaN layer (**14**) of Emerson would have pits formed within the InGaN/InGaN multilayer is provided by Tsujimura at column 1, lines 40-45 and Uchida at page 246, column 2, lines 2-7 where it is discussed the known formation of pits in InGaN/GaN multilayers.

Response to Arguments

6. Applicant's arguments, see page 3, filed 1/7/2009, with respect to the rejection(s) of claim(s) 33, 34, 36-44, and 46-50 under 102(b) have been fully considered and are not persuasive.

7. In the response dated 7 Jan. 2009 on page 3, line 9, Applicant states "To form the pits in Applicant's claimed invention, the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer is grown with H_2 being removed at first and second growth temperatures."

8. In the response dated 20 July 2009 on page 7, line 7, Applicant reiterates what is required to make the pits, however, additionally annotating paragraphs 39 and 43 of the specification.

9. In response, it appears that what is discussed at paragraph 43 is the more appropriate and controlling means for forming the hexagonal pits, "a plurality of hexagonal pits formed thereon due to dislocation and defects resulting from the doped N-type GaN layer". This position is made since forming superlattice structures are well-known in the art and hexagonal pits being formed in multi-layers grown in conditions not requiring removal of H_2 gas are known (Uchida and Tsujimura discussed below).

10. Applicant argues in the response dated 20 July 2009 on page 7, second and third paragraphs, that neither Emerson, McIntosh nor Biwa describes growing the layers of the $In_xGa_{1-x}N/In_yGa_{1-y}N$ multi-layer with H_2 gas removed and therefore cannot teach pits or pits formation.

11. The Examiner disagrees and takes the position in view of the paragraph 43 of Applicant's specification that states "a plurality of hexagonal pits formed thereon due to dislocation and defects resulting from the doped N-type GaN layer", the fact of forming superlattice structures are well-known in the art, and hexagonal pits being formed in multi-layers grown in conditions not requiring removal of H_2 gas are known, the multi-layer of Emerson would have said pits in multi-layer **16**. Further, the non-patent literature to Uchida et al. and U.S. 6,614,059 to Tsujimura further show that pits are present when forming InGaN/GaN multi-layers, showing evidence that the multi-layer of Emerson would have pits, although not explicitly illustrated.

The rejection of claims 33, 34, 36-44, 46-50 is maintained.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JESSE Y. MIYOSHI whose telephone number is (571)270-1629. The examiner can normally be reached on M-F 7:30 AM -5:00 PM EST. Alternating Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lynne A. Gurley can be reached on (571) 272-1670. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Lynne A. Gurley/
Supervisory Patent Examiner, Art Unit 2811

/Jesse Miyoshi/